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It's All Coming Back to Me Now: JHU Researchers Find Caffeine Enhances Memory

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For some, it's the tradition of steeping tealeaves to brew the perfect cup of tea. For others, it's the morning shuffle to a coffee maker for a hot jolt of java. Then there are those who like their wake up with the kind of snap and a fizz usually found in a carbonated beverage.

Regardless of the routine, the consumption of caffeine is the energy boost of choice for millions to wake up or stay up. Now, however, researchers at the Johns Hopkins University have found another use for the stimulant: memory enhancer.

[Michael Yassa](#), assistant professor of psychological and brain sciences in the Krieger School of Arts and Sciences at Johns Hopkins University, and his team of scientists, found that caffeine has a positive effect on long-term memory in humans. Their research, [recently published](#) in the journal *Nature Neuroscience*, shows that caffeine enhances certain memories for up to 24 hours after it is consumed.

"We've always known that caffeine has cognitive enhancing effects, but its particular effects on strengthening memories and making them resistant to forgetting has never been examined in detail in humans," said Yassa, the senior author on the paper. "We report for the first time a specific effect of caffeine on reducing forgetting over 24 hours."

The Johns Hopkins researchers conducted a double-blind trial in which participants who did not regularly eat or drink caffeinated products received either a placebo or a 200 milligrams caffeine tablet five minutes after studying a series of images. Salivary samples were taken from the participants before ingesting caffeine, and one, three and 24 hours afterwards to check for increased caffeine levels.

The next day, both groups were tested on their ability to recognize images from the previous day's study session. On the test, some of the visuals were the same as from the day before, some were new additions and some were similar but not the same as the items previously viewed. Researchers say more participants in the caffeine group were able to correctly identify the new images as "similar" to previously viewed images versus erroneously citing them as the same.

The brain's ability to recognize the difference between two similar but not identical items, called pattern separation, reflects a deeper level of memory retention, the researchers said.

"If we used a standard recognition memory task without these tricky similar items, we would have found no effect of caffeine," said Yassa. "However, using these items requires the brain to make a more difficult discrimination – what we call pattern separation, which seems to be the process that is enhanced by caffeine in our case."

The memory center in the human brain is the hippocampus, a seahorse-shaped area in the medial temporal lobe of the brain. The hippocampus is the switchbox for all short-term and long-term memories. Most research done on memory — the effects of concussions in athletics to war-related head injuries to dementia in the aging population — are focused on this area of the brain.

Until now, caffeine's effects on long-term memory had not been examined in detail. Of the few studies done, the general consensus was that caffeine has little or no effect on long-term memory retention.

The research is different from prior experiments because the subjects took the caffeine tablets only after they had viewed and attempted to memorize the images.

"Almost all prior studies administered caffeine before the study session, so if there is an enhancement, it's not clear if it's due to caffeine's effects on attention, vigilance, focus or other factors. By administering caffeine after the experiment, we rule out all of these effects and make sure that if there is an enhancement, it's due to memory and nothing else," said Yassa.

According to the U.S. Food and Drug Administration, 90 percent of people worldwide consume caffeine in one form or another. In

the United States alone, 80 percent of adults consume caffeine every day. The average adult has an intake of about 200 milligrams – the same amount used in the Yassa study – or roughly one strong cup of coffee or two small cups of coffee per day.

Yassa's team completed the research at Johns Hopkins [before the lab moved](#) to the University of California-Irvine at the start of this year.

“The next step for us is to figure out the brain mechanisms underlying this enhancement. We can use brain-imaging techniques to address these questions. We also know that caffeine is associated with healthy longevity and may have some protective effects from cognitive decline like Alzheimer's disease. These are certainly important questions for the future.”

The lead author of the paper is Daniel Borota, an undergraduate student in Yassa's lab who received an undergraduate research award from Johns Hopkins to conduct this research.

Additional authors, all from Johns Hopkins, are: Elizabeth Murray, a research program coordinator in the Department of Psychological and Brain Sciences; John Toscano, professor in the Department of Chemistry; Gizem Kecili, a graduate student also in the chemistry department and Allen Chang, Maria Ly and Joseph Watabe, all undergraduates in the Department of Psychological and Brain Sciences.

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